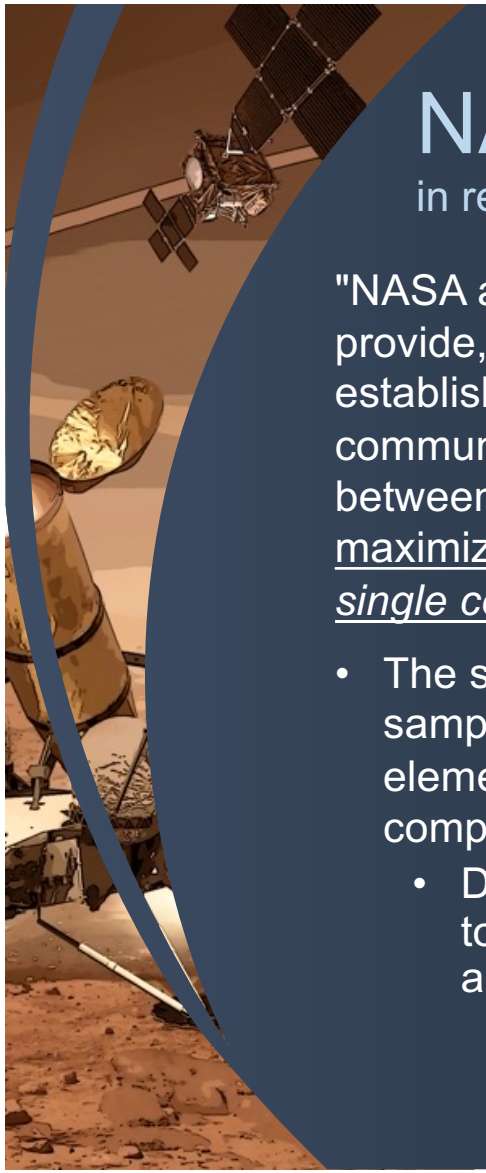

National Aeronautics and
Space Administration
EXPLORE
MARS SAMPLE RETURN
Jeff Gramling
Director, Mars Sample Return Program
Dr. Michael Meyer
Mars Lead Scientist
LPSC
March 8, 2022

GOAL —
First Sample Return From Another Planet

A priority since 1980 and of two National Academy Decadal Surveys
A first-step “round-trip” in advance of humans to Mars

The oldest known life on Earth existed ~3.5 billion years ago,
a time when Mars was habitable. Today,
<<1% of the Earth’s surface is 3 billion years or older
>50% of the Mars’ surface is 3 billion years or older

The first billion years and life’s beginning in the Solar System:
The record is on Mars

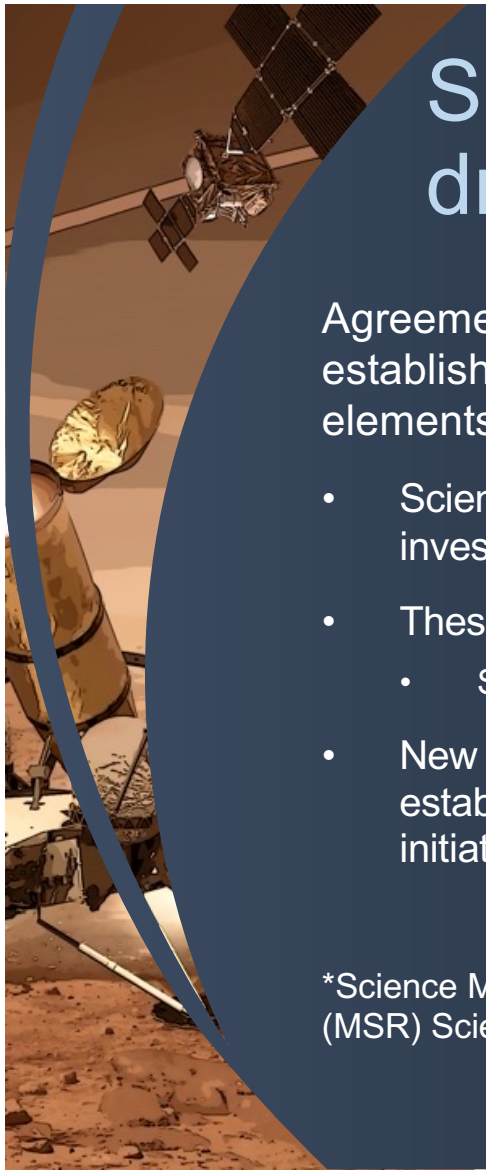


NASA ESA MSR Science MoU

in review, due June 2022

"NASA and ESA, through a dedicated joint body to be established, shall have and provide, equitable access to returned samples for scientific research, and shall establish procedures for open competition for access by the international scientific community. Use and curation of samples shall be governed by a future agreement between the Parties, and be based on the principles of transparency, scientific maximization, accessibility, return of investment, *and recognizing the samples as a single collection*." – NASA ESA MoU signed October 2020

- The scope of the **MSR Science MoU** covers the science management of the Mars samples, from the caching of M2020 samples, through the MSR program flight elements, to the sample handling, curation and scientific analyses on ground until completion of the first round of objective-driven science.
  - Does not intend to cover *any agreements* on the ground-based infrastructure to be used once the samples landed on Earth but permit the needed planning activities to prepare for handling the samples upon return to Earth.

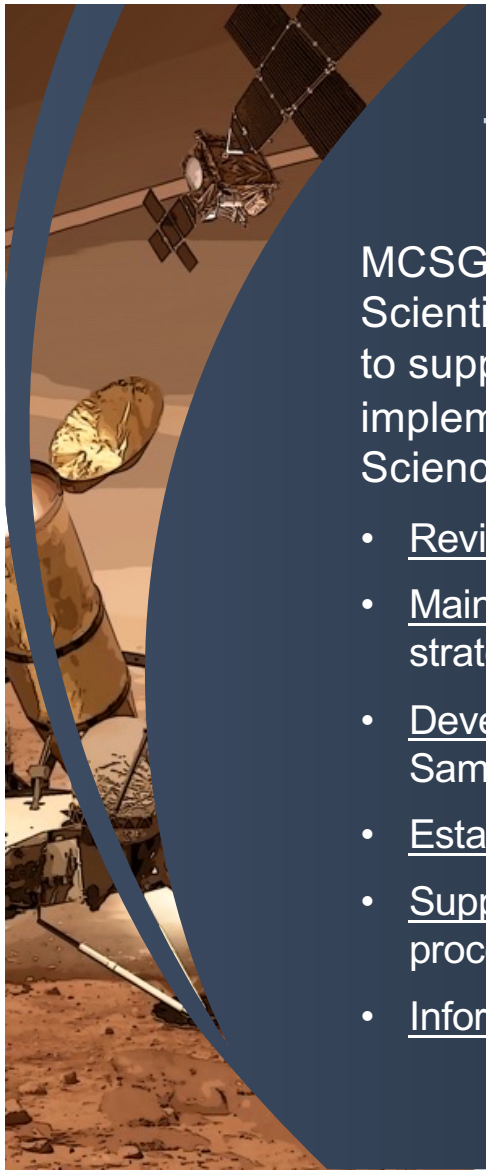


Science Management Plan draft Spring 2022

Agreements and funding for engineering elements of MSR have been established, but management, oversight, planning, and resources for scientific elements remain undefined

- Science functionalities required to carry out MSR include science leadership, science investigations, and involvement of the broader science community
- These functionalities are outside the scope of existing scientific bodies/activities
  - Some scientific functions covered by M2020, but most are not yet assigned
- New science bodies are needed for functionalities not yet assigned requires the establishment of an overarching MSR science management structure that should be initiated as soon as possible → MSR Campaign Science Group

*Science Management Plan based on: Rationale and Proposed Design for a Mars Sample Return (MSR) Science Program *Astrobiology*, Haltigen *et al.,* in press, doi: 10.1089/ast.2021.0122.



MSR Campaign Science Group phase 1
Terms of Reference in review for signatures

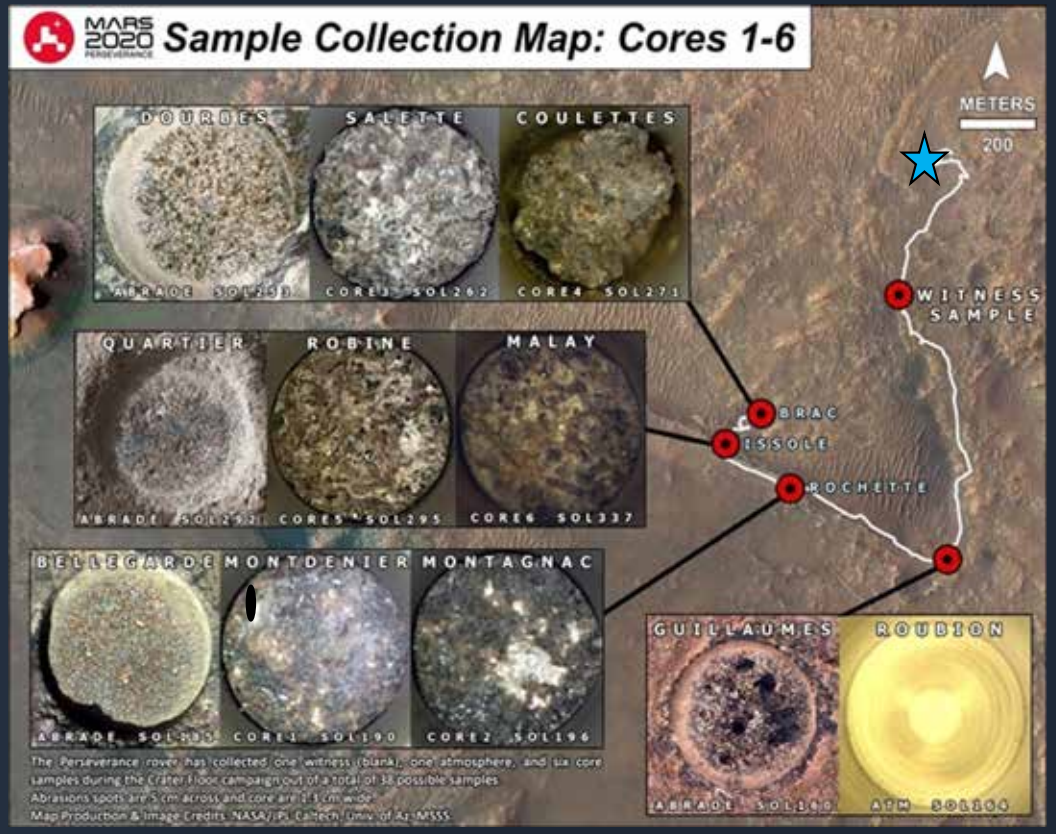
MCSG1 Selection Committee will be co-chaired by the NASA and ESA MSR Lead Scientists with members selected through an open, international, competitive call to support the Lead Scientists in the planning and oversight process during the implementation of the Science Management Plan and the execution of the MSR Science Program

- Reviewing Level 1 and derived science requirements
- Maintaining what constitutes a Scientifically Return Worthy (SRW) sample cache and strategy for depot formation
- Developing MSR science R&D roadmap; selection criteria for science team; MSR Sample Management Plan; Data Management Plan; and Communication Plan
- Establishing MSR science objectives and MSR science success criteria
- Supporting: depot location, science requirements for handling the samples, the NEPA process for the SRF, coordination with curation and planetary protection
- Informing and participating in the public outreach process

Samples Collected by Perseverance

Perseverance is headed counter-clockwise around Séítah dune area back by Octavia E. Butler Landing site. Will acquire the last rock sample on Jezero Crater floor before heading towards the Delta front.

Total 8 tubes sealed:
1 Witness blank
1 Atmospheric sample
3 pairs of rock core samples

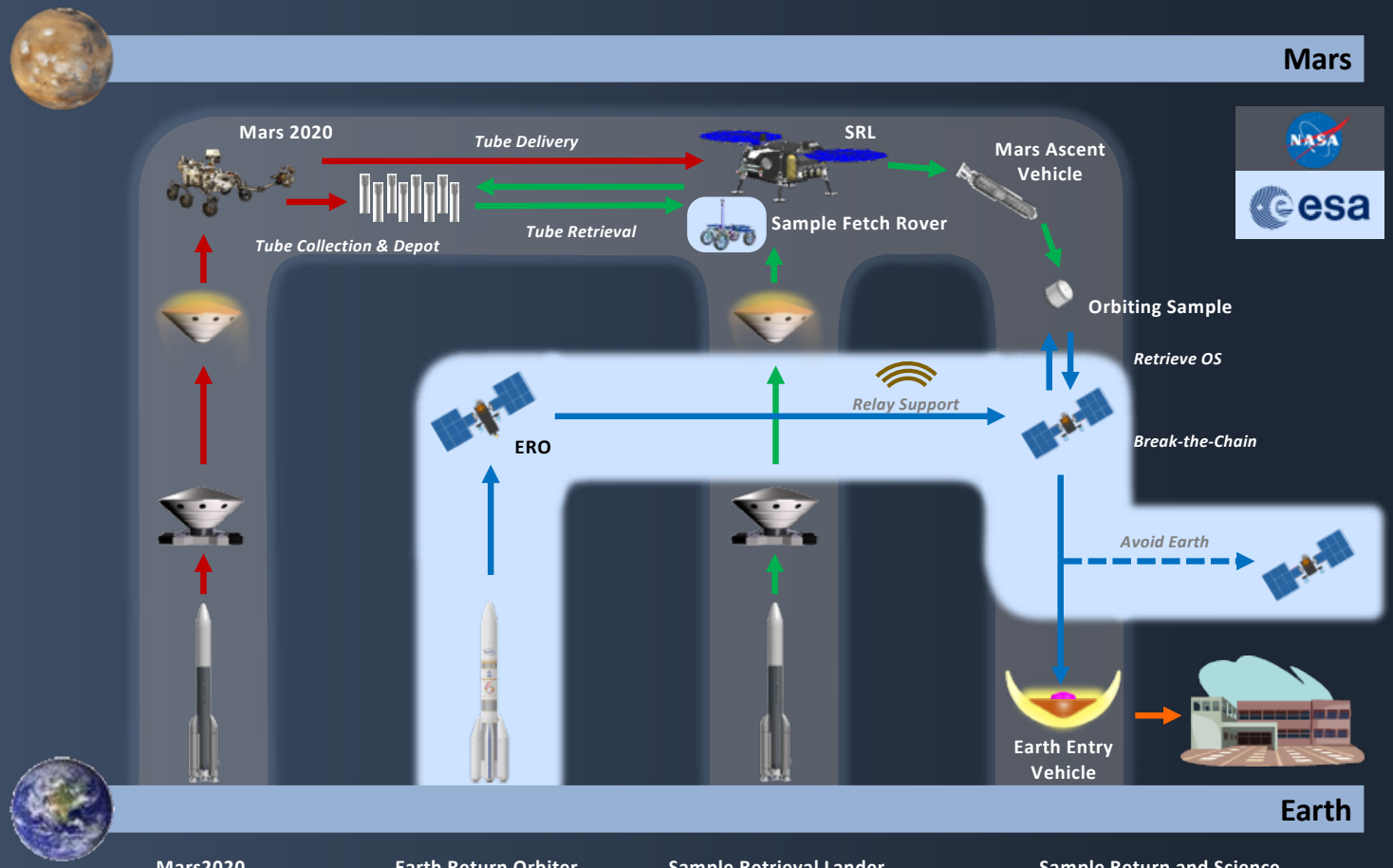


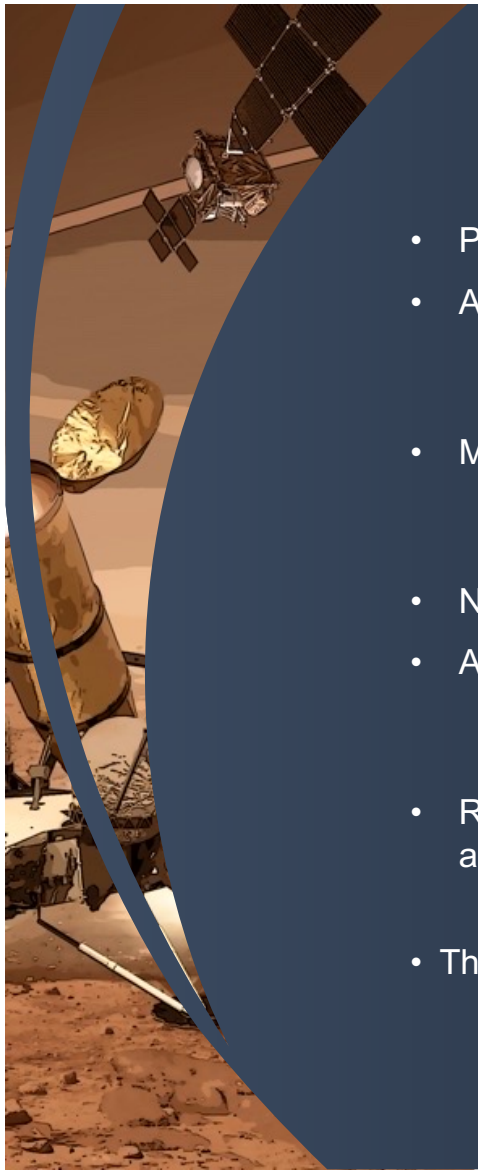
Courtesy of Fred Calef and M2020 team

Octavia E. Butler Landing Site

Sampling Sites

MSR Architecture Overview





Phase A Accomplishments

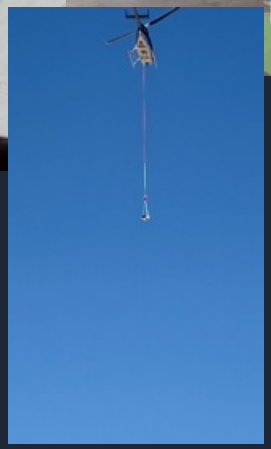
- Primary trades: Single vs. Dual Lander architecture, need for MMRTG, launch dates
- Addressed pre-formulation architecture issues
  - CCRS rearchitected to mitigate mass risk, establish viable on-orbit assembly approach
  - Established assurance case architecture for Back Planetary Protection to constrain future scope growth
- Matured Key Technology/Engineering Development
  - Advanced key technologies & engineering developments
  - Eliminated some key developments including aseptic brazing
- Negotiated critical engineering interface definitions with ESA partners (STA, SFR, ERO)
- Addressed potential Acquisition Risks
  - Simplified and consolidated NASA Center assignments
  - Established system level “buy” plans for MAV & EES Aeroshell
- Reached agreement with Agency stakeholders on overall Program Assurance Implementation approach
  - Reflects Class A approach, consistent with past Mars programs
- The Program System Requirements Review is scheduled for April 2022

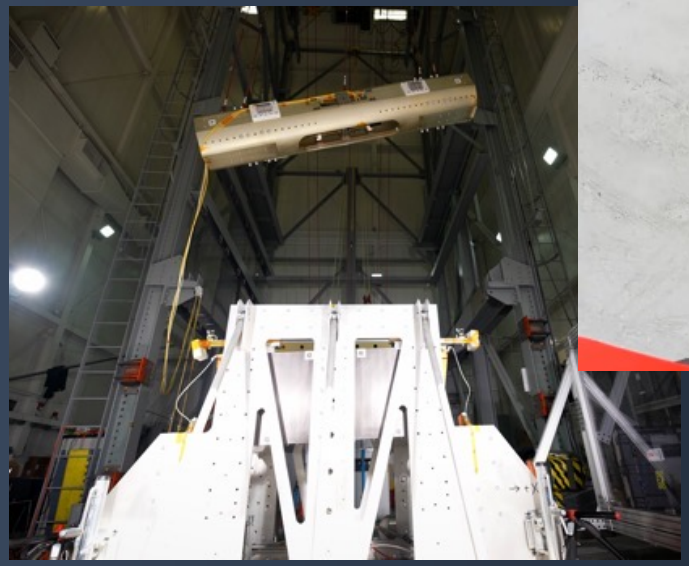
Technology and Engineering Development Progress

Technology and engineering developments continue with progress on several prototypes

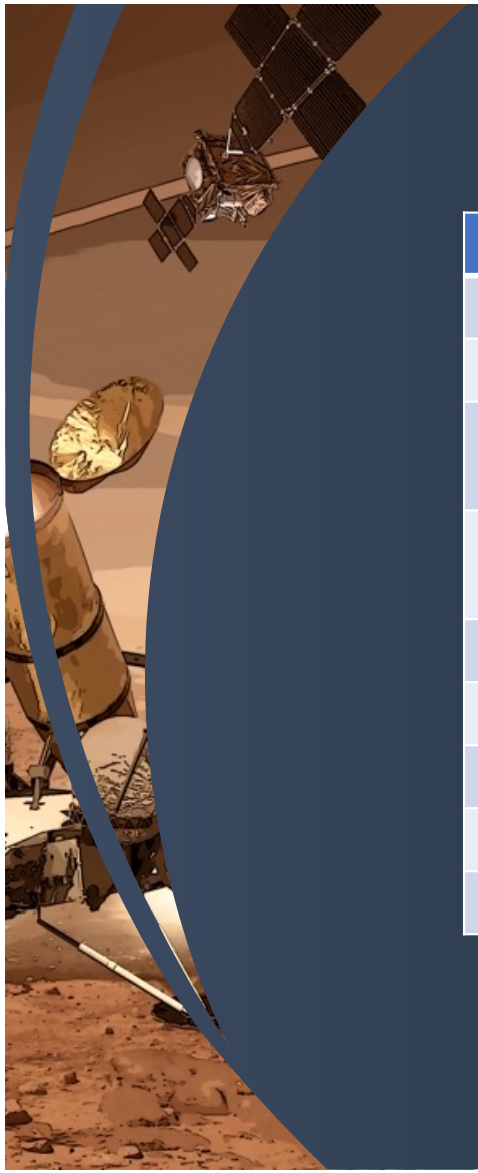
Landing Legs

Earth Entry System Drop Test



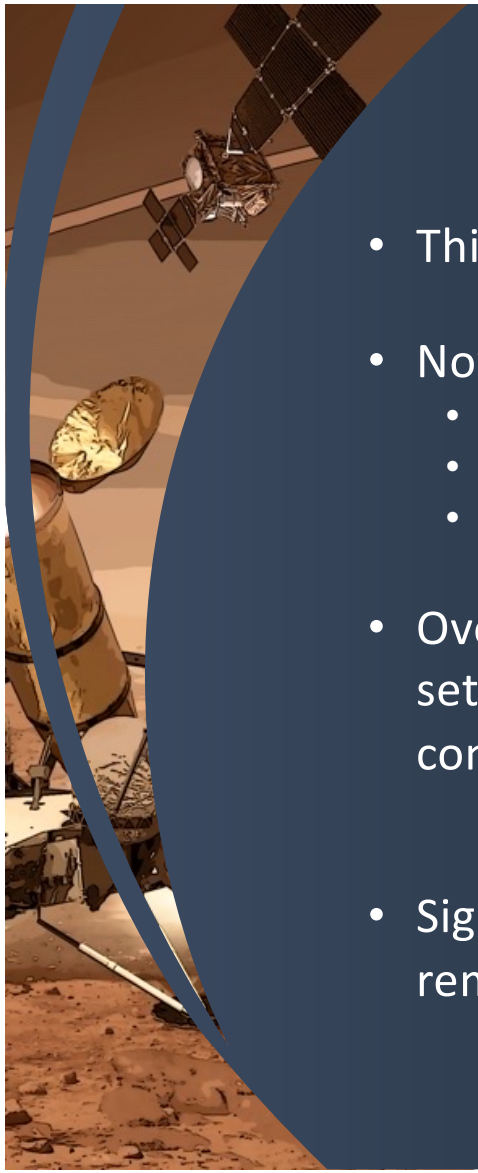


MAV VECTOR launch system



Primary Contract Awards

Task	Center	Project	Status	Vendor	Location
Cruise Stage	JPL	SRL-1	Awarded	LM	Colorado
Aeroshell	JPL	SRL-1	Awarded	LM	Colorado
MAPS (MAV SRM)	MSFC	SRL-1	Awarded	NGSC	Maryland
MAVIS (MAV System Int)	MSFC	SRL-1	Awarded	LM	Colorado & Alabama
EES/SRL TPS	ARC	CCRS	Awarded	FMI	Maine
Robotic Arm	JPL	CCRS	Awarded	Motiv	California
EES Aeroshell	JPL	CCRS	Awarded	LM	Colorado
Lander Engines	JPL	SRL-1	Awarded	Aerojet	Washington
Spin Eject Mech	GSFC	CCRS	Proposals Due	TBD	TBD



Summary

- This is the most significant planetary science undertaking in a generation
- Now is the time
  - Perseverance on surface of Mars collecting samples
  - Orbital Relay assets in place around Mars
  - European Partnership in place with substantial mission contributions
- Over the past three years, the NASA-ESA team has considered a broad set of implementation options and developed a feasible baseline concept
  - Key technologies and engineering developments have been matured
- Significant work remains, but the team is on track to launch the remaining flight elements in this decade


EXPLORE
with us